

Digital Video Camera

Photography will never be the same.



How Microneye Works

The heart of the Microneye is a low-cost, high resolution, solid-state 64K RAM video imaging chip with a transparent lid, so a computer can read the chip's output directly. Being a digital chip, each picture element (pixel) responds only to the part of the scene it views with an "on" or "off" (high or low) status signal.

The chip consists of 32768 elements arranged in 256 columns by 128 rows. When used as a memory chip, each element can be sent an electrical pulse to "set" it either "high" or "low" — to zero or to five volts — until the power is turned off, or until the computer changes the value of the bit. The computer can read each bit without changing the value of it. With the imaging chip, when light falls on an individual element or bit that has been set high, the voltage discharges toward zero volts. The speed with which it falls is proportional to the strength of the light. Until the voltage falls to less than about 2 volts, the computer will still read this bit as "high" or a "one." In the imaging mode the computer reads the level of each bit a fraction of a second after it has set the bit "high." This means the computer can only tell if the light that's falling on the chip is stronger than a certain value by sensing if the bit is low instead of high. If a lens focuses an image on the chip, different cells can be read as either high or low at any instant. The image can be sent to memory, also 256 by 128 elements in PMODE 4, which creates a black and white picture of the image focused on the chip.

By changing the time between the setting of imaging elements "high" and the reading of their value, the computer senses the different light levels falling on the various areas of the chip. This is the principle I have used to take different "exposure-time shots" of the same subject, and to color bits or pixels that are "low" differently for each exposure time.

The Microneye system software is two Basic programs and a machine-language driver program on one cassette. An assembly language program was included, too, presumably for use in developing modified machine-language programs.

The "Meye" Basic program runs on a 16K Extended Basic system and provides a menu of functions; run, change arrays, change picture size, set exposure time, reset, and exit. The picture size option provides a choice of four resolution/screen-display formats; 512 by 128, 256 by 128, 256 by 64, or 128 by 64. These numbers refer to the imaging chip pixels rather than the Color Computer display,

THE MICRONEYE DIGITAL imaging camera can, with the help of some software, provide multi-colored video images of people, photographs, and other subjects. Patience, however, is required to capture and process a good set of images.

The Microneye is not a substitute for a home video camera and recorder. You cannot aim, shoot, and instantly get TV-quality pictures. However, once a clear Microneye image is on the screen, you have something no video camera and recorder can offer — a digitized image for storage and processing.

Potential applications include the digitizing of drawings and photos, non-contact tracing and measuring of solid objects, and live video portraits. Storing images on tape or disk is one obvious related project. It may also be possible to communicate with the Color Computer without the keyboard, using hand signals through a windowpane, even from outdoors. Yet another project might be optical character recognition (text-reading), like postal service researchers are doing.

System Description

The system I used for my experiments was a small Microneye "bullet" camera

by Howard Bassen

with a standard TV camera lens mounted on a tripod. The camera was connected to an electronics package with a flat cable about four feet long and one inch wide. The three-by-nine inch electronics package plugged into the ROMpak port, so no disk operation was possible without an expansion box or a switch.

The electronics package that plugged into the ROMpak port provided interfacing functions between the computer and the camera system, and housed the driving electronics for the camera's chip. It also decoded commands from the computer.

The system drew power from the computer, so no ac plug was needed for the camera system. The electronics box plugged into the computer with a bare-board connector.

Behind the screw-on lens sat the imaging chip with two rectangular 32K-pixel arrays. These allow production of a full, square display rather than the rectangular display that would be produced by a single array.

since the PMODE 4 resolution is 256 by 192. The ARRAY command has a "1 array" or "2 array" option. If the "1 array" option is selected, only the top half of the video screen has an image produced on it, depending on the picture size selected. If the "2 array" option is selected, a full screen image can be obtained, again depending on the picture size selected. Here I found problems. There was a slight difference in the contrast levels of the two halves of the full-screen image, and there was a small portion of the image missing along the center line.

The final option available is to set the exposure time in milliseconds. Times range from $\frac{1}{1000}$ of a second to 10 seconds, with the "initial set-up" value being 100 milliseconds ($\frac{1}{10}$ second).

For a test image I used the Bob Dylan "Times They Are A-Changin'" record album jacket. That album jacket bears a photo of Dylan and some large block lettering. Using a 16mm focal length lens, I had to place the camera about four feet from the subject. With a 100 millisecond exposure and an incandescent bulb, I had to open the lens to its maximum value—f. 1.6. This made focusing critical, so I switched to much longer exposure times (600 to 1000 milliseconds), and operated at higher f stops, with their easier focusing (better depth of field). The images on the screen were clearly "binary"—either black or white pixels at each point on the screen. Absent were the many shades of gray that reveal subtle features.

After a little while I understood the basic requirements for getting decent images. I choose the distance from the subject to the lens to get the subject on the screen, re-aim the camera to center the subject on the screen, and experiment with exposure times and focusing.

Beyond The Instructions

No instructions are provided on how to freeze an image and store it on tape, so I wrote a simple program to do that, and another to transfer the tape image file to disk.

Then I decided to try out the imaging system with black-and-white photographs, line drawings and cartoons, a doll, and people willing to pose for portraits. Portraits were difficult until some friends and I discovered a trick that allowed us to bring out the features of a person's face. Light shining directly on a face from the front generates good contrast only between the hair and face. The camera could barely see a person's eyes, mouth, or glasses. But by holding the lamp (a 60 watt bulb in a spotlight hous-

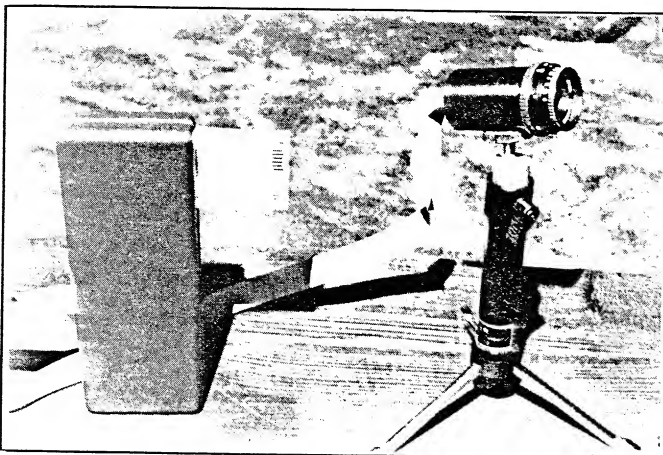
ing) above and at different angles to the person's face, shadows accenting their features were cast. By viewing the image on the TV screen while slowly moving the lamp around the subject a greatly improved portrait can be captured.

Taking video images of photographs was only moderately successful. Again, the lack of contrast between a person's face, for instance, and the background made certain features hard to see on the screen. Using a photographic profile of myself, the digitized image turned out reasonably well, due to the contrast between my beard and the background. However, my nose did not show up (see figure on title page). I tried some cartoons

made up of narrow lines and found that all lines did not show up reliably for the same exposure value. Multiple-image combining is needed to get improved computer images.

Multiple Image Combination

Micron says the limitations of the camera and its "binary images" can be overcome by storing several black-and-white images of the same subject, each taken with different exposure times. This process captures the different levels of gray in a black-and-white photo, or the different colors in a color photo, then stores them as several, individual black-and-white



*The Microneye
Digital View
System Camera*

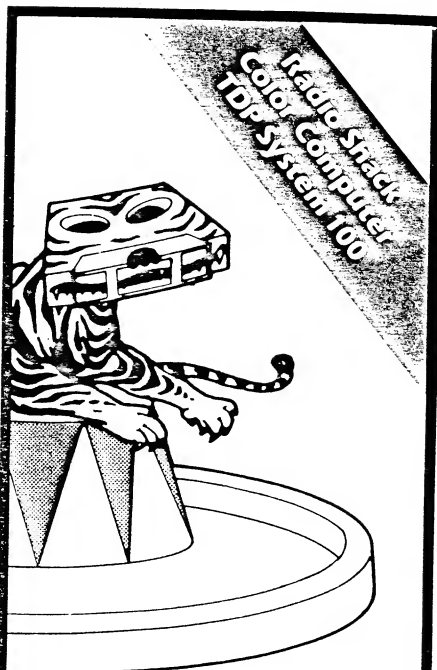
Program Listing. To Save Microneye Files to Tape

```

9990 REM PROGRAM TO SAVE "MEYE"
FILES TO TAPE. TO USE , ADD LIN
ES 10000 -10050 TO MEYE PROGRAM
AND RESAVE ON TAPE. TO OPERATE,
HIT THE SPACEBAR WHILE VIEWING
IMAGES, THEN CHOOSE OPTION <6> (
EXIT) AND THEN ' RUN 10000'
10000 CLS
10010 PRINT @0,"SELECT NUMBER OF
CHOICE"
10012 PRINT @ 32,"<1>-VIEW IMAGE
"
10014 PRINT @64,"<2>-SAVE IMAGE"

10016 PRINT @96,"<3>-RETURN TO M
AIN PROGRAM"
10018 INPUT V: IF V=1 THEN 10020
ELSE IF V=2 THEN 10040 ELSE IF
V=3 THEN 10050
10020 PMODE4,1:SCREEN1,1
10030 GOTO10030
10040 INPUT"FILE NAME?";W$:CSAVE
M W$,&H600,&H1DFF,&H600
10050 RUN

```



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Chromasette

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digital images. These different black-and-white images can be computer processed to provide a single multi-colored image, with each color representing the white pixels in one of the several "binary" images. Software for this is not provided by the manufacturer, so I wrote an Extended Basic program to do this "artificial color" conversion.

My program yields colorful images that bring out a subject's features in an abstract art, high-tech style. It loads in an individual binary image file (saved previously on tape or disk). By processing binary, black-and-white images of the same subject with different exposure times for each image, a four-color image can be created. The binary image is loaded into graphics pages five to eight and becomes a two-color image in pages one to four. By loading and processing several binary image files separately, with a different foreground color used for each output image, multi-color overlays are created on the same screen.

The program takes several minutes to process each black-and-white image, and you can have fun watching it scan vertically and coloring selected pixels on the screen. (I don't think it's important to speed up this process with assembly language graphics programming.)

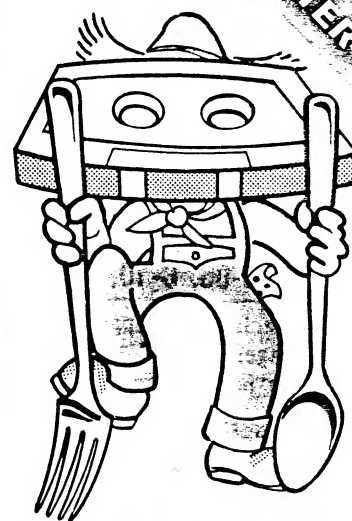
To improve on my portrait with the missing nose, I used the interactive drawing program "Drawer" (August, 1981 *Chromasette Magazine*) to add a nose and a forehead outline. This is all done using the arrow and other keys so that you can edit the picture on-screen, then save it on tape or disk. By viewing the color image in screen color sets 0 and 1, and in PMODEs 3 and 4, you can see many combinations of colors and contrasts. If you turn down the color control of your TV set, or if you use a black and white set, different colors appear on the screen as different shades of gray.

I recently saw the Radio Shack CGP 115 four-color graphics printer and a listing of a high-resolution screen dump program for the Color Computer. Imagine getting four-color images in hard-copy form!

If you would like copies of the raw (binary) and processed (artificial color) images for viewing and experimenting on tape, along with the color-processing, display-selection program of Listing 3, send \$7 to H.I.B. Software, 3505 Hutch Place, Chevy Chase, MD 20815.

The Microneye Camera is available from Micron Technology, Inc., 2805 East Columbia Rd., Boise, ID 83706, (208)383-4000. The cost of the system with lens, camera, electronics and software was recently listed as \$295. — Ed.

♦ Programs



TOOLS

Programs that make it easy to exploit the power and beauty of your Color Computer without making it hard on your wallet:

Graphics #1 - Displays and text delightfully manipulated! Watch and use First Cover, Drawer (the best drawing program anywhere), Graphtext (puts text on the graphics screen), Smalltext, Rotate (create and spin 3D objects in real time), World Map, 3D World, Star Map, String Art, Kaleidoscope, and Display Demo (text screen wizardry!)

Utilities #1 - Programming is simpler when you use Lister, Listmod, Newtrace (a better TRON), Lazkey (define keys as phrases), Append (easily combine two BASIC programs), BASIC Map, Varmap, Deleter, and CK Monitor (look at and modify memory).

Disk Utilities #1 - Harness the hidden powers of your disk system with Disk Edit (change things on disk directly), Disk Aid, Offset (EXECS most tape-only programs), Track Lock, DIR Save/Get (foil I/O errors), Cataloger, Master Catalog (keep track of your program library), and File Copy (a better BACKUP).

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Program Listing. To Transfer Files to Disk

```

1 REM PROGRAM TO TRANSFER MICRON
EYE IMAGE FILES FROM TAPE TO DISK
2 CLS: PRINT @ 0, "SELECT NUMBER
OF CHOICE"
3 PRINT @32, "AND <ENTER>"
4 PRINT @ 64, "<1>-LOAD TAPE FILE
AND VIEW"
5 PRINT @96, "<2>-SAVE TO DISK"
6 INPUT V: IF V=1 THEN 10 ELSE IF
V=2 THEN 100
10 CLS: INPUT "TAPE FILE NAME"; X$

20 CLOADM X$, &H800
30 PCLEAR8
40 PMODE4, 1: SCREEN1, 1
50 GOTO50
100 CLS: INPUT "DISK FILE NAME"; N$
110 SAVEM N$, PEEK(188)*256, PEEK(
188)*256+(1536*4)-1, 44553
120 END

```

Program Listing. To View, Save and Process

```

1 REM PROGRAM FOR MICRONEYE CAME
RA FILE PROCESSING, VIEWING AND
SAVING BY HOWARD BASSEN 16K EXT
BASIC
3 REM ****DISK OWNERS**** SEE LI
NES 81 AND 2011 FOR 32K DISK BA
SIC CONVERSION
5 PCLEAR8
10 CLS
20 PRINT @ 0, "SELECT NUMBER OF C
HOICE "
21 PRINT @32, "AND <ENTER>"
22 PRINT @ 64, "<1>-LOAD FILE"
24 PRINT @ 96, "<2>-PROCESS/CONVE
RT TO "
25 PRINT @ 132, "MULTI-COLOR"
26 PRINT @ 160, "<3>-VIEW IMAGES"

28 PRINT @ 192, "<4>-SAVE IMAGE"
30 INPUT V: IF V=1 THEN 60 ELSE
IF V=2 THEN 90 ELSE IF V=3 THEN
1000 ELSE IF V= 4 THEN 2000
ELSE 30
60 PRINT "LOAD LONGEST EXPOSURE
IMAGE FIRST"
70 INPUT "ENTER FILE NAME"; W$
75 AUDIOON

```



```

80 CLOADM W$, &H1800
81 REM FOR DISK SYSTEM SUBSTITUT
E THIS FOR LINE 80 : LOADM W$, &
H1800
85 END
90 INPUT "IS THIS FIRST IMAGE <Y/
N>?"; K$
100 IF K$="Y" THEN 110 ELSE 150
110 INPUT "SELECT BACKGROUND COLO
R 1=YELLOW 2=GREEN 3=BLUE 4=RE
D"; T
125 IF T<1 THEN 110
130 IF T>4 THEN 110
135 T=INT(T)
140 PMODE3,1:PCLS T
160 INPUT "ENTER FOREGROUND COLO
R 1=YELLOW 2=GREEN 3=BLUE
4=RED"; B:B=INT(B): IF B>4
THEN 160
170 IF B<1 THEN 160
180 PMODE4,5
190 SCREEN1,1
200 FOR I=1 TO 250 STEP 2
210 FOR J=1 TO 190
220 PMODE4,5
230 Y=PPOINT(I,J)
240 IF Y=5 GOSUB 290
250 NEXT J
260 PLAY "L20;A"
270 NEXT I
280 PLAY "A;B;C;":END
290 PMODE3,1:SCREEN1,1:PSET(I,J,
B)
300 RETURN

1000 CLS
1003 PRINT "ENTER <P> FOR PROCES
SED (COLOR) OR <U> FOR UNPROCESS
ED B/W IMAGE"
1004 INPUT B$: IF B$="P" THEN GOT
O 1005 ELSE IF B$="U" THEN GOTO
1020
1005 INPUT "COLOR SET <0 OR 1>"; M
:INPUT " PMODE <3 OR 4>"; L
1007 PMODEL,1:SCREEN1,M
1010 GOTO 1010
1020 PMODE4,5:SCREEN1,1
1030 GOTO 1030
2000 INPUT "FILE NAME"; V$
2010 CSAVEM V$, &H600, &H1DFF, &H60
0

2011 REM FOR DISK SYSTEM SUBSTIT
UTE THIS FOR LINE 2010 : SAVEM V
$, PEEK(188)*256, PEEK(188)*25
6+(1536*4), PEEK(188)*256

```

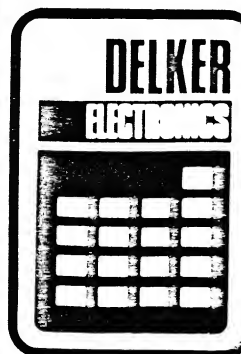
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26-3003 64k Extended CoCo	\$359.95
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